Amendments to the Claims

This Listing of Claims replaces all prior versions, and listings, of claims in this application.

1-321 (Cancelled).

322. (New) An electrophoresis apparatus, comprising:

a transport passage;

a separation passage having a passage overlapping portion overlapping a portion of the transport passage;

analyte concentrator containing an immobilized affinity ligand in the passage overlapping portion to concentrate an analyte of interest from a sample introduced into the transport passage;

the transport passage entering the separation passage at a side entry location of the analyte concentrator and exiting the separation passage at a side exit location spaced a distance along a length of the separation passage and thereby offset a distance from the separation portion at the entry location, the overlapping portion extending between the entry location and the exit location to form a staggered configuration for the analyte concentrator;

first valve means for controlling the flow of at least one sample of one buffer from an inlet to an outlet of the transport passage and;

second valve means for controlling the flow of at least one buffer in the separation passage from an inlet to an outlet of the separation passage and to an analyte detector system that identifies and characterizes the analyte of interest delivered thereto by electrophoresis migration, pressure or a combination of electrophoresis migration and pressure.

323. (New) The electrophoresis apparatus of claim 322 wherein the analyte concentrator includes a matrix assembly having a surface to which the immobilized affinity ligand is bound.

324. (New) The electrophoresis apparatus of claim 323 wherein the matrix assembly includes a plurality of microstructures.

325. (New) The electrophoresis apparatus of claim 323 wherein the analyte concentrator retains the matrix assembly by pressure-resistant porous end walls disposed in the transport passage and the separation passage.

326. (New) The electrophoresis apparatus of claim 323 wherein the matrix assembly includes a fixed architecture defined by beaded microstructures interconnected to each other and to the passage overlapping portion.

327. (New) The electrophoresis apparatus of claim 323 wherein the matrix assembly includes a fixed architecture fabricated from polymeric microstructures interconnected to each other and to the passage overlapping portion.

328. (New) The electrophoresis apparatus of claim 322 wherein the separation passage is capable of separating by at least one mode of capillary electrophoresis the analyte of interest retained by the immobilized affinity ligand after the analyte is released from the affinity ligand.

329. (New) The electrophoresis apparatus of claim 322 further comprising an auxiliary passage coupled to the separation passage downstream of the analyte concentrator to provide a fluid to the separation passage away from the analyte concentrator, and valve means for controlling fluid flow out of the auxiliary passage.

330. (New) The electrophoresis apparatus of claim 322 further comprising an auxiliary analyte concentrator on the separation passage and downstream of the analyte concentrator, the auxiliary analyte concentrator having affinity ligands capable of retaining chromophores to bind the analyte of interest released from the analyte concentrator to improve the sensitivity and selectivity of the analyte of interest.

331. (New) The electrophoresis apparatus of claim 322 wherein the separation passage is filled with an electrically conductive fluid.

332. (New) The electrophoresis apparatus of claim 322 wherein the separation passage is filled with a gel matrix and an electrically conductive fluid.

333. (New) The electrophoresis apparatus of claim 322 further comprising an auxiliary passage through which a separation buffer can be provided to the separation passage, and positioned between the analyte concentrator and the detector system.

334. (New) The electrophoresis apparatus of claim 322 wherein the immobilized affinity ligand is capable of performing at least one chemical or biochemical reaction.

335. (New) The electrophoresis apparatus of claim 322 wherein the analyte concentrator has an encapsulated cellular or subcellular structure to carry out drug metabolism studies.

336. (New) The electrophoresis apparatus of claim 322 wherein the analyte concentrator has an acoustic micromixing system positioned externally.

337. (New) The electrophoresis apparatus of claim 322 wherein the analyte concentrator has a microwave pulse system positioned externally.

338. (New) The electrophoresis apparatus of claim 322 wherein the affinity ligand is covalently bound to a matrix assembly of the analyte concentrator.

339. (New) The electrophoresis apparatus of claim 322 wherein the detector system is an ultraviolet detector system.

340. (New) The electrophoresis apparatus of claim 322 wherein the detector system is a fluorescence or laser-induced fluorescence detector system.

341. (New) The electrophoresis apparatus of claim 322 wherein the detector system is a conductivity, electrochemical, radioactive, mass spectrometer, circular diochroism or nuclear magnetic resonance detector system.

342. (New) The electrophoresis apparatus of claim 322 wherein the separation passage defines a first separation passage, the analyte of interest defines a first analyte of interest, the analyte concentrator defines a first analyte concentrator, and the passage overlapping portion defines a first passage overlapping portion; and further comprising a second separation passage having a second passage overlapping portion overlapping a portion of the transport passage, and a second analyte concentrator containing an immobilized affinity ligand in the second passage overlapping portion to concentrate a second analyte of interest from the sample introduced into the transport passage.

343. (New) The electrophoresis apparatus of claim 342 wherein the first and second separation passages merge into a single exit outlet passage.

344. (New) The electrophoresis apparatus of claim 343 wherein the second valve means controls, at the merging of the separation passages into the exit outlet passage, the sequential fluid flow from the first and second separation passages to the exit outlet passage.

345. (New) The electrophoresis apparatus of claim 342 further comprising an exit outlet passage into which the first and second separation passages flow and positioned at a detection zone of the analyte detector system, and wherein the second valve means controls the sequential fluid flow in the first and second separation passages to the detection zone.

346. (New) The electrophoresis apparatus of claim 322 wherein passage bulging members retain the immobilized affinity ligand in the passage overlapping portion.

347. (New) The electrophoresis apparatus of claim 322 wherein the inner diameter of the transport passage is larger than the inner diameter of the separation passage.

348. (New) The electrophoresis apparatus of claim 322 wherein the first and second valve means include valves on the transport passage on both sides of the analyte

concentrator and valves on the separation passage on both sides of the analyte concentrator.

349. (New) The electrophoresis apparatus of claim 322 wherein the transport passage and the separation passage are both capillaries.

350. (New) The electrophoresis apparatus of claim 322 wherein the transport passage and the separation passage are both channels.

351. (New) The electrophoresis apparatus of claim 322 wherein the immobilized affinity ligand is covalently adsorbed to the passage overlapping portion.

352. (New) The electrophoresis apparatus of claim 322 wherein the first valve means includes transport passage valves and separation passage valves, and wherein the transport passage valves are adapted to be opened and the separation passage valves are adapted to be closed to allow the sample to pass through the analyte concentrator towards an outlet end of the transport passage.

353. (New) The electrophoresis apparatus of claim 322 wherein the second valve means includes transport passage valves and separation passage valves, and wherein the transport passage valves are adapted to be closed and the separation passage valves are adapted to be opened to allow buffer solution to pass through the analyte concentrator and in the separation passage towards the detector system.

354. (New) An electrophoresis apparatus, comprising:

a transport passage;

a first analyte concentrator including immobilized affinity ligands which are attracted to a first analyte of interest;

a first separation passage to convey by electrophoresis migration the first analyte of interest from a sample transported in the transport passage and concentrated by the first analyte concentrator at a first location of the transport passage to a detector system which identifies and characterizes the first analyte of interest and which identifies and characterizes a second analyte of interest;

the transport passage having a first staggered configuration at the first location for the first analyte concentrator;

the first separation passage being communicable upstream of the first staggered configuration with a buffer supply;

a second analyte concentrator including immobilized affinity ligands which are attracted to the second analyte of interest;

a second separation passage to convey by electrophoresis migration the second analyte of interest from the sample transported in the transport passage and concentrated by the second analyte concentrator at a second location of the transport passage to the detector system;

the transport passage having a second staggered configuration at the second location for the second analyte concentrator;

the second separation passage being communicable upstream of the second staggered configuration with a buffer supply; and

a valve system to control fluid flow in the transport passage and the separation passages.

355. (New) The electrophoresis apparatus of claim 354 wherein the buffer supply of the first separation passage includes a separation buffer and an eluting buffer to release the bound first analyte of interest from the immobilized affinity ligands of the first analyte concentrator.

356. (New) The electrophoresis apparatus of claim 354 wherein the first analyte concentrator includes a matrix assembly having a surface to which the immobilized affinity ligand is bound.

357. (New) The electrophoresis apparatus of claim 356 wherein the matrix assembly includes a plurality of microstructures.

358. (New) The electrophoresis apparatus of claim 356 wherein the analyte concentrator retains the matrix assembly by pressure-resistant porous end walls disposed in the transport passage and the first separation passage.

359. (New) The electrophoresis apparatus of claim 356 wherein the matrix assembly includes a fixed architecture defined by beaded microstructures interconnected to each other and to the first separation passage.

360. (New) The electrophoresis apparatus of claim 356 wherein the matrix assembly includes a fixed architecture fabricated from polymeric microstructures interconnected to each other and to the first staggered configuration.

361. (New) The electrophoresis apparatus of claim 354 wherein the first separation passage is capable of separating the first analyte of interest retained by the immobilized affinity ligand after the analyte is released from the affinity ligands and of separating the released analyte by at least one mode of capillary electrophoresis.

362. (New) The electrophoresis apparatus of claim 354 further comprising a valve-controlled auxiliary passage coupled to the first separation passage downstream of the first analyte capillary to provide a fluid to the first separation passage away from the first analyte concentrator.

363. (New) The electrophoresis apparatus of claim 354 further comprising an auxiliary analyte concentrator on the first separation passage and downstream of the first analyte concentrator, the auxiliary analyte concentrator having affinity ligands capable of retaining chromophores to bind the first analyte of interest released from the analyte concentrator to improve the sensitivity and selectivity of the first analyte of interest.

364. (New) The electrophoresis apparatus of claim 354 wherein the first separation passage is filled with an electrically conductive fluid.

365. (New) The electrophoresis apparatus of claim 354 wherein the first separation passage is filled with a gel matrix and an electrically conductive fluid.

366. (New) The electrophoresis apparatus of claim 354 wherein the first immobilized affinity ligand is capable of performing at least one chemical or biochemical reaction.

367. (New) The electrophoresis apparatus of claim 354 wherein the first analyte concentrator has an encapsulated cellular or subcellular structure to carry out drug metabolism studies.

368. (New) The electrophoresis apparatus of claim 354 wherein the first analyte concentrator has an acoustic micromixing system positioned externally.

369. (New) The electrophoresis apparatus of claim 354 wherein the first analyte concentrator has a microwave pulse system positioned externally.

370. (New) The electrophoresis apparatus of claim 354 wherein the affinity ligands of the first analyte concentrator are covalently bound to a matrix assembly of the first analyte concentrator.

371. (New) The electrophoresis apparatus of claim 354 wherein the detector system is an ultraviolet detector system.

372. (New) The electrophoresis apparatus of claim 354 wherein the detector system is a fluorescence or laser-induced fluorescence detector system.

373. (New) The electrophoresis apparatus of claim 354 wherein the detector system is a conductivity, electrochemical, radioactive, mass spectrometer, circular diochroism or nuclear magnetic resonance detector system.

374. (New) The electrophoresis apparatus of claim 354 wherein the first and second separation passages merge into a single exit output passage.

375. (New) The electrophoresis apparatus of claim B21 wherein the second valve means controls, at the merging of the first and second separation passages, the sequential fluid flow from the first and second separation passages to the exit output passage.

376. (New) The electrophoresis apparatus of claim 354 further comprising an exit outlet passage into which the first and second separation passages flow and at a

detection zone of the analyte detector system, and wherein the valve system controls the sequential fluid flow of the first and second separation passages to the detection zone.

377. (New) The electrophoresis apparatus of claim 354 wherein passage bulging members retain the immobilized affinity ligands in the first analyte concentrator.

378. (New) The electrophoresis apparatus of claim 354 wherein the inner diameter of the transport passage is larger than the inner diameters of the first and second separation passages.

379. (New) The electrophoresis apparatus of claim 354 wherein the valve system include valves on the transport passage on both sides of the first analyte concentrator and valves on the separation passage on both sides of the first analyte concentrator.

380. (New) The electrophoresis apparatus of claim 354 wherein the transport passage and the first and second separation passages are all capillaries.

381. (New) The electrophoresis apparatus of claim 354 wherein the transport passage and the first and second separation passages are all channels.

382. (New) The electrophoresis apparatus of claim 354 wherein the immobilized affinity ligands of the first analyte concentrator are covalently adsorbed to the first staggered configuration.

383. (New) The electrophoresis apparatus of claim 354 wherein the valve system includes transport passage valves and separation passage valves, and wherein the transport passage valves are adapted to be opened and the first separation passage valves are adapted to be closed to allow the sample to pass through the first analyte concentrator towards an outlet end of the transport passage.

384. (New) The electrophoresis apparatus of claim 354 wherein the valve system includes transport passage valves and first separation passage valves, and wherein the transport passage valves are adapted to be closed and the first separation passage

valves are adapted to be opened to allow buffer solution to pass through the first analyte concentrator and in the first separation passage to the detector system.

385. (New) An electrophoresis apparatus, comprising:

a transport passage;

a first analyte concentrator which is a first concentrator-microreactor with first immobilized affinity ligands which are attracted to a first analyte of interest;

a first separation passage to convey by electrophoresis migration the first analyte of interest from a sample transported in the transport passage and concentrated by the first immobilized affinity ligands at a first location of the transport passage to a detector system which identifies and characterizes the first analyte of interest;

the transport passage having a first staggered configuration at the first location for the first concentrator-microreactor;

a second analyte concentrator which is a second concentrator-microreactor with second immobilized affinity ligands which are attracted to a second analyte of interest;

a second separation passage to convey by electrophoresis migration the second analyte of interest from the sample and concentrated by the second immobilized affinity ligands at a second location of the transport passage to the detector system which identifies and characterizes the second analyte of interest;

the transport passage having a second staggered configuration at the second location for the second concentrator-microreactor; and

a valve system to control fluid flow in the passages, the valve system including valves operatively around the first staggered configuration and valves operatively around the second staggered configuration.

386. (New) The electrophoresis apparatus of claim 385 wherein the first analyte concentrator includes a matrix assembly having a surface to which the first immobilized affinity ligands are bound.

387. (New) The electrophoresis apparatus of claim 386 wherein the matrix assembly includes a plurality of microstructures.

388. (New) The electrophoresis apparatus of claim 386 wherein the first analyte concentrator retains the matrix assembly by pressure-resistant porous end walls disposed in the transport passage and the first separation passage.

389. (New) The electrophoresis apparatus of claim 386 wherein the matrix assembly includes a fixed architecture defined by beaded microstructures interconnected to each other and to the first staggered configuration.

390. (New) The electrophoresis apparatus of claim 386 wherein the matrix assembly includes a fixed architecture fabricated from polymeric microstructures interconnected to each other and to the first staggered configuration.

391. (New) The electrophoresis apparatus of claim 385 wherein the first separation passage is capable of separating the first analyte of interest retained by the first immobilized affinity ligands after the first analyte is released from the first immobilized affinity ligands.

392. (New) The electrophoresis apparatus of claim 391 wherein the first separation passage is capable of conveying the released analyte by at least one mode of capillary electrophoresis.

393. (New) The electrophoresis apparatus of claim 385 further comprising an auxiliary passage coupled to the first separation passage downstream of the first analyte concentrator to provide a fluid to the first separation passage away from the first analyte concentrator.

394. (New) The electrophoresis apparatus of claim 385 further comprising an auxiliary analyte concentrator on the first separation passage and downstream of the first analyte concentrator, the auxiliary analyte concentrator having affinity ligands capable of retaining chromophores to bind the first analyte of interest released from the first analyte concentrator to improve the sensitivity and selectivity of the first analyte of interest.

395. (New) The electrophoresis apparatus of claim 385 wherein the first separation passage is filled with an electrically conductive fluid.

396. (New) The electrophoresis apparatus of claim 385 wherein the first separation passage is filled with a gel matrix and an electrically conductive fluid.

397. (New) The electrophoresis apparatus of claim 385 wherein the first immobilized affinity ligands are capable of performing at least one chemical or biochemical reaction.

398. (New) The electrophoresis apparatus of claim 385 wherein the first analyte concentrator has an encapsulated cellular or subcellular structure to carry out drug metabolism studies.

399. (New) The electrophoresis apparatus of claim 385 wherein the first analyte concentrator has an acoustic micromixing system positioned externally.

400. (New) The electrophoresis apparatus of claim 385 wherein the first analyte concentrator has a microwave pulse system positioned externally.

401. (New) The electrophoresis apparatus of claim 385 wherein the first affinity ligands are covalently bound to a matrix assembly of the first analyte concentrator.

402. (New) The electrophoresis apparatus of claim 385 wherein the detector system is an ultraviolet detector system.

403. (New) The electrophoresis apparatus of claim 385 wherein the detector system is a fluorescence or laser-induced fluorescence detector system.

404. (New) The electrophoresis apparatus of claim 385 wherein the detector system is a conductivity, electrochemical, radioactive, mass spectrometer, circular diochroism or nuclear magnetic resonance detector system.

405. (New) The electrophoresis apparatus of claim 385 further comprising an exit outlet passage into which the first and second separation passages flow and positioned at a detection zone of the detector system.

406. (New) The electrophoresis apparatus of claim 405 wherein the valve system sequentially controls the fluid flow in the first and second separation passages to the detection zone.

407. (New) The electrophoresis apparatus of claim 385 wherein passage bulging members retain the first immobilized affinity ligands in the first staggered configuration.

408. (New) The electrophoresis apparatus of claim 385 wherein the inner diameter of the transport passage is larger than the inner diameters of the first and second separation passages.

409. (New) The electrophoresis apparatus of claim 385 wherein the valve system include valves on the transport passage on both sides of the first analyte concentrator and valves on the first separation passage on both sides of the first analyte concentrator.

410. (New) The electrophoresis apparatus of claim 385 wherein the transport passage and the first and second separation passages are all capillaries.

411. (New) The electrophoresis apparatus of claim 385 wherein the transport passage and the first and second separation passages are all channels.

412. (New) The electrophoresis apparatus of claim 385 wherein the first immobilized affinity ligands are covalently adsorbed to the first staggered configuration.

413. (New) The electrophoresis apparatus of claim 385 wherein the valve system includes transport passage valves and first separation passage valves, and wherein the transport passage valves are adapted to be opened and the first separation passage valves are adapted to be closed to allow the sample to pass through the first analyte concentrator towards an outlet end of the transport passage.

414. (New) The electrophoresis apparatus of claim 385 wherein the valve system includes first transport passage valves and separation passage valves, and wherein the first transport passage valves are adapted to be closed and the separation passage valves are adapted to be opened to allow buffer solution to pass through the first analyte concentrator and in the first separation passage towards the detector system.

415. (New) An electrophoresis apparatus, comprising:

a transport passage capable of directing flow of a sample solution to be analyzed;

a plurality of separation passages coupled to the transport passage and forming a plurality of analyte concentrators having immobilized affinity ligands capable of attracting at least one target analyte from the sample solution that passes through each of the analyte concentrators;

a plurality of valves located on the transport passage and on the plurality of separation passages, wherein the valves on the transport passage control the flow of the sample solution through the transport passage and the valves on the plurality of separation passages control the flow of fluid through each of the plurality of separation passages, and conveyed by electrophoresis migration to a detector system; whereby each of the analyte concentrators can be localized by the valves on the transport passage and the plurality of separation passages; and

the transport passage being staggered from one of the separation passages to the next separation passage to form elongated staggered concentration areas for each of the analyte concentrators.

416. (New) The electrophoresis apparatus of claim 415 wherein each of the analyte concentrators includes a matrix assembly having a surface to which the immobilized affinity ligands are bound.

417. (New) The electrophoresis apparatus of claim 416 wherein the matrix assemblies include a plurality of microstructures.

418. (New) The electrophoresis apparatus of claim 416 wherein the analyte concentrators retain the matrix assemblies by pressure-resistant porous end walls disposed in the transport passage and the separation passages.

419. (New) The electrophoresis apparatus of claim 416 wherein the matrix assemblies include a fixed architecture defined by beaded microstructures interconnected to each other and to the staggered concentration areas.

420. (New) The electrophoresis apparatus of claim 416 wherein the matrix assemblies include a fixed architecture fabricated from polymeric microstructures interconnected to each other and to the staggered concentrator areas.

421. (New) The electrophoresis apparatus of claim 415 further comprising a valve-controlled auxiliary passage coupled to one of the separation passages downstream of the analyte concentrator to provide a fluid to that separation passage away from that analyte concentrator.

422. (New) The electrophoresis apparatus of claim 415 further comprising an auxiliary analyte concentrator on one of the separation passages and downstream of the analyte concentrator, the auxiliary analyte concentrator having affinity ligands capable of retaining chromophores to bind the analyte of interest released from that analyte concentrator to improve the sensitivity and selectivity of that analyte of interest.

423. (New) The electrophoresis apparatus of claim 415 wherein each of the separation passages is filled with an electrically conductive fluid.

424. (New) The electrophoresis apparatus of claim 415 wherein each of the separation passages is filled with a gel matrix and an electrically conductive fluid.

425. (New) The electrophoresis apparatus of claim 415 wherein the detector system is an ultraviolet detector system.

426. (New) The electrophoresis apparatus of claim 415 wherein the detector system is a fluorescence or laser-induced fluorescence detector system.

427. (New) The electrophoresis apparatus of claim 415 wherein the detector system is a conductivity, electrochemical, radioactive, mass spectrometer, circular diochroism or nuclear magnetic resonance detector system.

428. (New) The electrophoresis apparatus of claim 415 wherein the transport passage and the separation passages are all capillaries.

429. (New) The electrophoresis apparatus of claim 415 wherein the transport passage and the separation passages are all channels.